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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/629,884	07/29/2003	Hardayal Singh Gill	HSJ920030125US1	5556

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EXAMINER	
UHLIR, NIKOLAS J	

ART UNIT	PAPER NUMBER
1773	

DATE MAILED: 09/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/629,884	GILL, HARDAYAL SINGH	
	Examiner	Art Unit	
	Nikolas J. Uhlir	1773	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *41* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-41* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Specification

The attempt to incorporate subject matter into this application by reference to commonly owned us patent application identified by docket number HSJ920030006US1/00507.0500-US-01 on page 14, line 16 of the specification is improper because it references the co-owned U.S. application by docket number, not application number. The applicant is respectfully requested to amend the specification so as to reference the incorporated subject matter by its U.S. application number.

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 14 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter that was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 14 requires the barrier layer to have a thickness of about 3 to about 6 "Δ". The unit of thickness specified by the applicant, namely "Δ" is not a known unit of thickness and is not defined in the specification. Furthermore, there are no examples in the specification which elucidate which conventional unit of thickness (nm, μ, mm, etc.) the unit "Δ" is intended to represent. Thus, one of ordinary skill in the art, looking at the

disclosure provided by the applicant, would not be able to make and use the invention commensurate with the claimed thickness.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 14 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The unit "Δ" is not a known unit of thickness and is not explained/defined in either the specification or the claims. As a result, the examiner cannot discern what thickness range claim 14 is intended to encompass.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-8 and 10, and 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramoto et al. (US2003/0017723).

Regarding claim 1. The limitations "and incorporating diffusion components migrated from the at least one magnetic layer" is a process limitation in a product claim and is does not appear to be further limiting in so far as the structure of the product is concerned. Even though product claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a

product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985). See MPEP § 2113.

Bearing the above in mind, the examiner interprets claim 1 to require a magnetic tunnel junction device comprising a first magnetic layer and a second magnetic layer, a barrier layer between said first magnetic layer and said second magnetic layer, wherein at least one of the magnetic layers and the barrier layer contain a component that modifies one or more properties of the tunnel junction device, such that the component contained in the at least one magnetic layer and the barrier layer are the same.

Hiramoto teaches a tunneling magnetoresistive (TMR) device comprising a substrate, a first magnetic layer on the substrate, a high resistance layer on the first magnetic layer, and a second magnetic layer on the high resistance layer (section 63). IN many places in the disclosure, Hiramoto refers to "junction resistance" (see abstract) and "the tunnel junction" (section 63), so the examiner considers the TMR of Hiramoto to be equivalent to applicants claimed magnetic tunnel junction device.

The first and second magnetic layers are formed from a magnetic metal alloy comprising at least one element M (which can be Fe, Ni, Co) combined with element R_{cp} (which can be Zr, Hf, Mg, Ca, etc.) (sections 66 and 73). Hiramoto specifically discloses that a FeCo alloy, containing element R_{cp}, is suitable for forming the first and/or second magnetic layers (section 66).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a FeCo alloy containing Zr or Hf to form the first and/or second magnetic layers taught by Hiramoto.

One would have been motivated to specifically select a FeCo alloy containing Hf or Zr in view of the fact that Hiramoto specifically discloses FeCo as a suitable magnetic alloy containing at least one element M, and recognizes the equivalence of Zr and Hf to the other elements listed as suitable R_{cp} elements.

Hiramoto discloses that the high resistance layer can be selected from various materials, so long as those materials contain at least one element L_{onc} (where L_{onc} can be O, N, or C) (section 68). Specific examples of high resistivity layer materials include Al_2O_3, AlN, BN, and others (section 68).

Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize Al_2O_3 to form the high resistance layer taught by Hiramoto.

One would have been motivated to specifically select Al_2O_3 in view of the fact that Hiramoto recognizes the equivalence of Al_2O_3 to the other compositions listed as suitable for use in forming the high resistance layer.

Bearing the above in mind, Hiramoto teaches heat-treating the TMJ device after the formation of the high resistance layer. As a result, element L_{onc} in the high resistance layer reacts with element R_{cp} in either the first or second magnetic layer to form a compound (section 13). The compound itself functions as part of the high-resistivity layer (section 13).

From the above disclosure, it is the examiners position that when Al_2O_3 is utilized as the initial high resistivity layer and an alloy of FeCo containing Hf or Zr is utilized as either the first or second magnetic layer, upon heating of the TMR (per the teachings of Hiramoto), oxygen from the Al_2O_3 layer will react with Hf or Zr in the magnetic layer to form a compound. Specifically, the examiner takes the position that an aluminum oxide containing Hf or Zr will be formed and will function as part of the high resistivity layer. The Hr or Zr present in both the high resistivity layer and the magnetic layer after heating is considered to be equivalent to applicants claimed diffusion components. Though Hiramoto does not disclose that these elements adjust the specific properties required by the instant claims, the examiner takes the position that these limitations are met in view of the fact that the materials utilized for the magnetic layer, high resistance layer, and R_{cp} in Hiramoto are the same as those disclosed in the instant claims for the magnetic layers, barrier layer, and diffusion components respectively.

7. Claims 2-4 require the diffusion components to adjust various properties. Hiramoto does not disclose that element R_{cp} is selected to adjust these properties. However, when Hf and Zr are utilized as element R_{cp}, the examiner takes the position that the limitations of claims 2-4 are met in view of the fact that these elements are identical to those disclosed by the applicant in the specification which adjust the claimed properties.

8. Claim 5 requires the first magnetic layer to be a pinned layer and the second magnetic layer to be a free layer. Hiramoto discloses that either the first or second magnetic layers can be pinned through the use of an adjacent antiferromagnetic (AFM)

layer (section 65). Thus, when this AFM layer is utilized adjacent either the first or second magnetic layer. The limitation of a pinned magnetic layer is met. Though Hiramoto does not disclose that the non-pinned magnetic layer is a free magnetic layer as required by the claims, one of ordinary skill in the art would recognize that the non-pinned layer of Hiramoto would function as a free magnetic layer, as the structure of a conventional TMR device includes 2 magnetic layer separated by a insulating layer, wherein one of the magnetic layers is pinned by an AFM layer and the other is a free layer. Aside from explicitly disclosing that the 2nd magnetic layer is a free magnetic layer, the general structure recited by Hiramoto is identical/substantially similar structures conventionally known in the art.

9. Claim 6 requires on of the magnetic layers to be a multilayer structure, Hiramoto discloses that the first or second magnetic layers can be a dual layer, wherein a FeCo containing element R_{cp} layer is formed on a FeCo magnetic layer, such that the FeCo containing R_{cp} layer is closer to the high resistivity layer than the FeCo layer (section 14). Thus, this limitation is met when this dual layer structure is used.

10. Claims 7-8, 10, and 12-16 are met as set forth above.

11. Claims 17-26, 28-37 and 39-41 rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramoto as applied to claims 1-8, 10, and 12-16 above, and further in view of Gill (US6097579).

12. Hiramoto does not disclose a magnetic tunnel junction sensor having a current source and a magnetoresistance detector coupled to the 1st and second magnetic

layer, as required by claim 17. However, it is noted that Hiramoto does disclose the TMR device is suitable for forming a MR sensor (sections 184-185).

13. Bearing the above in mind, Gill teaches an MTJ sensor comprising a pinned magnetic layer, an insulating layer on the pinned layer, and a free magnetic layer on the insulating layer, wherein a current source is connected via leads to the pinned and free magnetic layers and a signal detector is coupled to the leads (column 2, lines 38-62). This sensor is suspended above a recording medium via an actuator arm 315 (figure 2 and column 2, lines 38-62). A spindle 314 is provided to rotate the medium (figure 2 and column 2, lines 38-62).

14. Therefore it would have been obvious to one of ordinary skill in the art to suspend the TMR device of Hiramoto over a movable recording medium, and attach a current source and a detector to the device per the teachings of Gill so as to achieve a functional TMJ sensor.

15. One would have been motivated to make these modifications in view of the teaching in Hiramoto that the TMR device is suitable for use as a MR sensor, and the teaching in Gill that a current source and a detector are essential elements of a TMJ sensor, and that such a sensor is appropriately attached to an actuator arm and suspended over a movable recording medium so as to form a sensor device.

16. Claims 18-26, 28-37 and 39-41 are met as set forth above for claims 1-8, 10, and 12-17 above.

17. Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramoto as applied to claims 1-8, 10, and 12-16 above, and further in view of Gallagher et al (US5640343).

18. Hiramoto fails to teach the limitations of claim 28, which requires a memory device including an array of memory elements comprising MTJ's having a structure substantially similar to that required by claim 1. However, it is noted that Hiramoto does teach that the TMR de vice is suitably used in MRAM (section 185).

19. Bearing this in mind, Gallagher teaches the formation of an MRAM device from an array of interconnected MTJ devices (figures, and column 2, lines 33-52).

20. Therefore it would therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a MRAM memory device per the teachings of Gallagher utilizing the TMR devices taught by Hiramoto.

21. One would have been motivated to make this modification in view of the teaching in Hiramoto that the TMR sensors can be utilized in forming a MRAM device, and the teaching in Gallagher that an MRAM device can be formed by an array of interconnected TMJ sensors.

22. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramoto as applied to claims 1-8, 10, and 12-16 above, and further in view of Slaughter et al. (US2004/0041183).

23. Hiramoto fails to disclose the use of about 5-10 atomic % Hf, as required by claim 9.

24. However, Slaughter teaches a magnetoresistive tunnel junction structure comprising a pinned layer structure 214, an insulating layer 216, and a free magnetic layer 228 (figure 2 and section 21). The pinned layer structure comprises two magnetic layers separated by a coupling layer (figure 2 and section 21). The two magnetic layers in the pinned layer structure are formed from an amorphous magnetic alloy such as CoFeD, where D is a dopant element such as HF or Ta (sections 24 and 28). The amount of dopant D utilized in the magnetic layers of the pinned layer structure should be in the range of 5-15 atomic % (section 29).

25. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize 5 atomic % Hf as taught by Slaughter in the CoFe alloy magnetic layers taught by Hiramoto.

26. One would have been motivated to make this modification in view of the teaching in Hiramoto that CoFeHf alloys are suitable for use in forming the magnetic layers of a TMR device, and the teaching in Slaughter that a CoFeHf alloy containing 5 atomic % HF is especially suited for forming a magnetic alloy utilized in a MTJ (a type of TMR device).

27. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hiramoto as modified by Slaughter as applied to claim 9 above, and further in view of Makino et al (US6449133).

28. Hiramoto as modified by Slaughter above fails to disclose a CoFe alloy containing about 5-10 atomic % Zr, as required by claim 11. However, it is noted that

Hiramoto teaches the use of generic CoFeZr alloys, and that Slaughter teaches the use of a CoFeD alloy in a magnetic tunnel junction, where D is present in an amount from 5-15 atomic % and is an element resulting in a stable amorphous alloy (section 28). Ta HF and B are specifically listed as suitable D elements (section 28).

29. Bearing the above in mind, Makino teaches a magnetoresistive thin film utilizing a pinned layer formed from an amorphous magnetic alloy (column 1, lines 40-45). Suitable amorphous alloys which are useable for the pinned layer of the magnetoresistive film include CoFeB and CoFeZr (column 3, lines 30-35).

30. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize 5 atomic % Zr in the CoFeZr alloy layers taught by Hiramoto.

31. One would have been motivated to make this modification in view of the teaching in Hiramoto that CoFeZr alloys can be utilized for the magnetic layers, the teaching in Slaughter that CoFeD alloys can be used as the pinned layer in a magnetoresistive structure (where D is an element resulting in a stable amorphous magnetic film and is contained in an amount of 5-15 atomic %), and the teaching in Makino that CoFeZr is a known amorphous alloy. In other words, Makino teaches that the addition of Zr to CoFe results in stable amorphous alloy. Thus, Zr is suitable for use as a D element in Slaughter (this is especially clear given the teaching of equivalence in Makino of CoFeB and CoFeZr alloys and the explicit teaching in Slaughter that CoFeB is a suitable amorphous alloy). Slaughter teaches that CoFe films containing 5-15 atomic % of

element D are especially suitable for use in magnetoresistive films, and Hiramoto teaches the use of CoFeZr thin films in a TMR device.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nikolas J. Uhlir whose telephone number is 571-272-1517. The examiner can normally be reached on Mon-Fri 7:30 am - 5 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Deborah Jones can be reached on 571-272-1535. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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D. S. NAKARANI
PRIMARY EXAMINER